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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

04013277.1

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

Anmeldung Nr:
Application no.: 04013277.1
Demande no:

Anmeldetag:
Date of filing: 04.06.04
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Capsule for two-component materials

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

A61C/

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL
PL PT RO SE SI SK TR LI

CAPSULE FOR TWO-COMPONENT MATERIALS

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

The present invention relates to a capsule for two or more components of a material which are to be mixed together. The material can be a dental material, for example an impression material, a temporary restoration material or a filler material.

DESCRIPTION OF THE RELATED ART

In the dental sector, that is to say the sector involving dentists and dental technicians, various capsules are known for intraoral administration of materials consisting of one component or of two or more components which are to be mixed together. There are so-called "compules", liquid/powder capsules, and paste/paste capsules.

The compule is a capsule having a cannula, a single chamber containing a one-component material and opening at the front into the cannula, and a piston which sits in the chamber at the rear. Such compules can contain, for example, the universal filler material Filtek™ Supreme and the universal composite Filtek™ Z250 available from 3M ESPE. For use, they have to be inserted into an applicator (shown in FIG. 55) which, for example, is available from 3M ESPE as Capsule dispenser under article number 5706 SD or from Centrix™. These known applicators each have a body with a handgrip, a holder for receiving the compule in a removable manner, a plunger, and a drive mechanism for the plunger. When the capsule sits in the holder and the drive mechanism is actuated by closing the hand, said drive mechanism then pushes the plunger into the chamber from the rear, so that said plunger initially bears on the piston and pushes it farther forwards. By means of the advance movement of the

piston, the material is dispensed from the chamber through the cannula. Such compule applicators are very widely available on the market.

The liquid/powder capsules contain a liquid component and a powder component which have to be kept separate from one another until the time of use. Such liquid/powder capsules are, for example, available under the names Aplicap™ and Maxicap™ from 3M ESPE. These capsules contain, for example, the two components, to be mixed together, of filler materials such as, for example, the glass ionomer filler material Ketac™ Molar, or the light-cured glass ionomer filler material Photac™ Fil Quick, or the silver-reinforced glass ionomer filler material Ketac™ Silver Molar, or luting cements such as, for example, the self-adhesive universal composite luting cement RelyX™ Unicem or the adhesive composite luting cement Compolute™ or the glass ionomer luting cement Ketac™ Cem. These known capsules have a cannula, a large mixing chamber which contains the powder and opens at the front into the cannula, a piston which sits at the rear in the mixing chamber, and a foil pouch which contains the liquid and covers a hole in the shell or outer wall of the chamber. To use it, the capsule is first activated by applying pressure in a suitable way to the foil pouch, so that the latter tears over the hole and the liquid is forced into the mixing chamber. The mixing chamber is larger than the joint volume of the two components, so that these can be mixed together by vigorous agitation, for example using the capsule mixer devices RotoMix™ or CapMix™ from 3M ESPE. They then have to be inserted into a suitable applicator, which for example is obtainable under the name Aplicap™ Applier (shown in FIG. 56) or Maxicap™ Applier from 3M ESPE. These known applicators each have a body with a handgrip, a holder for receiving the capsule in a removable manner, a plunger, and a drive mechanism for the plunger. When the capsule sits in the holder and the drive mechanism is actuated by closing the hand, said drive mechanism then pushes the plunger into the mixing chamber from the rear, so that said plunger initially bears on the piston and pushes it farther forwards. By means of the advance movement of the piston, the

material is dispensed from the mixing chamber through the cannula. Such applicators for liquid/powder capsules are likewise widely available on the market.

The paste/paste capsules contain two pasty components which have to be kept separate from one another until the time of use. Such a paste/paste capsule is known from WO 97/21394, which additionally discloses an applicator for this capsule. This known capsule has a cannula, a static mixer, which sits in the cannula, two cylindrical chambers lying alongside one another and opening at the front into the cannula, and two cylindrical pistons which sit displaceably in the rear of the chambers. The known applicator has a body with a handgrip, a holder for receiving the capsule in a removable manner, two elongate plungers lying alongside one another, and a drive mechanism for the two plungers which, when the capsule sits in the holder, advances these into the two chambers from the rear. The chambers contain the two pasty components which, upon actuation of the applicator drive mechanism, are pressed forwards out of the chambers and into the cannula by the two pistons which are pushed farther into the chambers by the two plungers. Upon further flow through the cannula, the two component strands are mixed together by means of the mixer and finally dispensed as a ready-mixed material from the front of the cannula.

The paste/paste capsule known from WO 97/21394 cannot be used with the known compule applicators described above, nor with the above-described known applicators for liquid/powder capsules, both of which forms are widely available on the market, because these each have only a single plunger, while the known paste/paste capsule has two pistons.

SUMMARY OF THE INVENTION

The present invention provides the advantage that the capsule can be designed without great expense in such a way that it matches the com-

pule applicators already available on the market or the applicators for liquid/powder capsules. In this way it is possible to avoid the expense of producing a new applicator and bringing it onto the market.

In a first aspect, the present invention relates to a capsule for two or more components of a material which are to be mixed together, comprising:

- a cartridge comprising a first component chamber for containing a first component and a second component chamber for containing a second component;
- a housing comprising an outlet and a cartridge chamber for holding the cartridge, the cartridge chamber being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

In a second aspect, the present invention relates to a capsule for two or more components of a material which are to be mixed together, comprising:

- a first cartridge comprising a first component chamber for containing a first component;
- a second cartridge comprising a second component chamber for containing a second component;
- a housing comprising an outlet and a cartridge chamber for holding the cartridges, the cartridge chamber being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

In a third aspect, the present invention relates to a capsule for two or more components of a material which are to be mixed together, comprising:

- a first cartridge comprising a first component chamber for containing a first component;
- a second cartridge comprising a second component chamber for containing a second component;
- a housing comprising an outlet, a first cartridge chamber for holding the first cartridge, and a second cartridge chamber for holding the second cartridge, the first and second cartridge chambers being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

Further preferred features and embodiments of the invention are described in the claims.

It may be provided that the cartridge is made from a different material than the housing.

It may be provided that the cartridge is made from a different material than the piston.

It may be provided that the housing is made from a different material than the piston.

It may be provided that the first piston is connected to or formed in one piece with the second piston.

It may be provided that at least one of the pistons is connected to or formed in one piece with at least one of the cartridges.

It may be provided that at least one of the component chambers has at least one opening closed by a seal.

It may be provided that the seal is a film attached to the cartridge.

It may be provided that the seal is formed in one piece with the cartridge.

It may be provided that the seal is a membrane formed in one piece with the cartridge.

It may be provided that the capsule comprises a piercing member for piercing the seal.

It may be provided that the first component chamber has a rear opening closed by the first piston.

It may be provided that:

- the first piston has a front end;
- the first component chamber has a rear opening for receiving the first piston;
- the front end is connected to or formed in one piece with a part of the cartridge surrounding the rear opening and closes the rear opening.

It may be provided that the first component chamber has a rear section holding a plug.

It may be provided that the plug is formed in one piece with a part of the cartridge surrounding the rear section.

It may be provided that the plug is made from a different material than the cartridge.

It may be provided that the plug comprises a through hole running from the outside to the inside of the first component chamber.

It may be provided that:

- the plug has a rear face;

- the plug comprises a filling nipple protruding from the rear face;
- the through hole runs through the filling nipple.

It may be provided that the capsule comprises a stopper for closing the through hole.

It may be provided that the plug has a front face with a funnel shaped surface leading to the through hole.

It may be provided that:

- the plug is made from an elastic material;
- the through hole is collapsed at least when the plug sits in the first component chamber.

It may be provided that:

- the cartridge comprises an outer wall with a cylindrical outer surface;
- the cartridge chamber comprises a cylindrical inner surface facing the outer surface when the cartridge is held in the cartridge chamber;
- a tongue and groove joint is provided on the outer surface and the inner surface.

It may be provided that:

- the cartridge comprises a partition wall between the first component chamber and the second component chamber;
- the groove of the tongue and groove joint runs along the line where the partition wall meets the outer wall.

It may be provided that at least the outer wall of the cartridge is made from a material containing at least one nano filling substance. For example, by adding a suitable nano filling substance the oxygen permeation through the outer wall of the cartridge may be increased while maintain-

ing the water vapor barrier so that an anaerobic polymerization of a component contained in the component chamber adjacent this outer wall, may be prevented.

It may be provided that at least the outer wall of the cartridge is made from a generally transparent material which is opaque for certain wave length. One example is a transparent orange material which is opaque for blue light.

It may be provided that:

- at least the first component chamber has a rear section holding a permeable piston which is permeable to air but impermeable to the first component;
- the permeable piston has a front face contacting the first component contained in the first component chamber.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the invention are described in more detail below with reference to the attached drawings, which are by way of example only.

PASTE CARTRIDGE (FIG. 1+2)

The body or housing of the capsule (FIG. 1) can be designed as a hollow cylinder (without separating or partition wall) for receiving a two-chamber or multi-chamber container or cartridge (FIG. 2), the capsule thus being in two parts. It is advantageous here that the container can be designed to permit optimal aging stability of the pastes, while the capsule includes further functional elements.

The proposed solutions all relate to the packaging of pastes, which are to be understood as including liquid to pasty substances, preferably for dental applications. The container used is preferably a cylindrical cartridge

with two or more channels or chambers which are arranged on the longitudinal axis of the cylinder and receive the pastes. Optionally, it is possible to use an individual cartridge for each paste component (Advantages in manufacturing pastes with several colour shades: one component contains the different shades, while the other always has the same composition and can be produced in larger batch numbers).

It is also advantageous that the cartridge can be made of a material which is optimized in respect of the storage of the substance with which it is filled, while the capsule can be configured with design or labeling requirements in mind. For example, the capsule can be colour-coded depending on the type of filling material (e.g. a filling material for different tooth colours). The cartridge, however, can be made of the same material for all substance types, e.g. can be transparent in order to avoid colour penetration into the substance with which it is filled. Or can be made of dark material in order to take account of the photosensitivity of the substance with which it is filled.

A cartridge designed in this way can be easily sealed off with foils at its ends (lower picture in FIG. 1).

Instead of the sealing foil, one end can be closed off with a membrane formed integrally with the cartridge (e.g. injection-molded).

Such an arrangement affords in particular the possibility of a self-opening mechanism (FIG. 3+4) for the front end of the two-chamber container. For example, the inside of the capsule can have piercing elements for the cartridge (FIG. 3). When the plunger of the applicator presses on the piston, said piston is moved, together with the cartridge, towards the piercing elements, whereupon the front foil is punctured. The piercing elements can effect initial piercing of the foil, so that the foil tears as the paste is advanced. A further possibility involves piercing elements with an

internal channel through which the pastes flow forwards to the mixing cannula (FIG. 4).

The piercing elements can be connected to the capsule or to the mixer or can be formed integrally with one of these two parts.

INTEGRALLY MOLDED CARTRIDGE WITH PISTON (FIG. 5-7)

In one possible design, the cartridge and the piston can be formed integrally or in a two-component injection-molding process. Here, the connection between cartridge and piston is designed such that the connection ruptures when the piston is advanced. This can be achieved by making the connection between the two parts very thin, e.g. the pistons can be connected to the chambers only at the edges of the components (FIG. 5+6). However, the parts can also be connected to one another by a thin membrane (FIG. 7).

With a predetermined breaking point of suitable design, this breaking point could be used to advantage. If piston and cartridge are connected to one another via a thin membrane (FIG. 7), the latter is expanded before breaking, so that the shape of the membrane is slightly greater than the cross section of the chambers. In this way, the membranes act as sealing elements when the piston is advanced. The sealing effect can also be assisted by suitable shaping of the membrane, e.g. as an umbrella or circular lip seal in such a manner that the sealing effect increases with increasing pressure.

INTEGRALLY INJECTION-MOLDED CARTRIDGE WITH CLOSURE AND FILLING DEVICE (FIG. 8-12)

In one variant, the cartridge can be provided with detachable closures, e.g. plugs. The closures are preferably formed integrally with the cartridge. A through-bore allows the cartridge, already sealed at the front

end, to be filled via the closures, e.g. by immersion filling, the metering needles lying at the filling level of the substance used for filling. Vacuum filling can alternatively be used instead of immersion filling.

After the filling procedure, the filling nipples arranged on the closures are closed off, e.g. by squeezing with heated or unheated tools. The squeezing can be done using tools with two, three or more jaws. This ensures that the filling procedure is carried out free from air bubbles. Instead of squeezing, it is also possible to seal the filling nipples by means of a (e.g. heated) wire loop, so that, instead of a wide seal seam, a substantially round pressing is obtained. Alternatively, the filling nipples can be closed by twisting them. The nipples are preferably heated for this purpose. Sealing would also be possible if the inner surface of the nipple is contaminated with paste (depending on the filled paste).

Optionally, the pistons can be made conical at the end (FIG. 11) so that the filled substance can flow without forming air inclusions.

In one option, the cartridge can be made of elastic material, and thus the nipple too can be made elastic. It is advantageous that the closures do not have to be provided with open through-bores, but can be punctured with pointed filling needles. After removal of the filling needles, the openings close automatically. It is also possible for the cartridge to be injection-molded from rigid material and for the closures to be injection-molded from elastic material in the two-component injection-molding process.

Another obvious option is for the cartridge, unsealed at the front, to be filled from the front end. In this case, openings are not necessary in the closures. After the cartridge has been filled, it is closed by means of a thermally applied or adhesive sealing foil.

CLOSURE NIPPLE WITH STOPPER (FIG. 12)

Instead of sealing the closure nipple, provision can also be made for the filling bores to be closed with a stopper. The stopper can contain an overflow volume so that, when pressed into the filling bore, it displaces substance, which is taken up by the overflow volume, and thus closes free from air. It is possible to seal the stopper, e.g. by ultrasound. For ultrasonic welding, it is possible to provide energy flow directors in the form of bulges or ridges.

LOCKING THE CARTRIDGE

To ensure that the cartridge does not migrate rearwards when the paste is dispensed (paste can flow under cartridge at the end), a snap-fit lock is proposed. For example, locking hooks can be arranged on the inside of the capsule and snap into corresponding catches on the cartridge as soon as the cartridge is pressed into its front end position. A bayonet-type closure could also be provided between cartridge and capsule.

PRE-MIXING CHAMBER

The capsule can contain a pre-mixing chamber which, before they flow into the static mixer, divides the two substance components A and B into several (e.g. 4) paste streams A, B, A, B and brings these back together to form two paste streams, which however each consist of at least two different substance components A and B. This can be achieved by each substance component, even as it flows out of the capsule, being divided into two or more paste streams which are then conveyed farther on the capsule end face through a type of labyrinth and are brought together in the above-described manner. The advantage of this is that a pre-mixing chamber cuts down the overall structural length, because the actual static mixer in the cannula can be supplied with already pre-mixed substance and can therefore be made shorter.

SECURING THE CARTRIDGE AGAINST TWISTING (FIG. 13+14)

In order to orient the cartridge in the capsule, the cartridge can be provided with at least one notch, preferably along the line nearest to the separating or partition wall on the outer wall or shell of the cartridge. It is advantageous here that the natural sink marks (FIG. 13) arising in the injection-molding process can simultaneously be avoided or used as positioning groove. Moreover, by arranging the groove in the area of the separating wall, influences on the permeation properties of the cartridge are substantially avoided. Optionally, it is possible to provide just one groove (FIG. 14), resulting in a more distinct orientation of the cartridge with respect to the capsule. Alternatively, a raised bridge can be arranged on the cartridge. Both bridge and groove can extend along the entire length of the cartridge or only along part of its length. The capsule has the geometrical counterpart which engages in the groove of the cartridge or which receives the bridge on the cartridge.

NANOFILLERS (E.G. NANOCLAY) IN SUBSTANCE FOR CARTRIDGE

It is possible to use substances with nanofillers, e.g. in order to increase the storage stability of the filled substances. For example, addition of nanofillers can increase oxygen permeation through the cartridge wall (e.g. to prevent anaerobic polymerization of the component adjacent this cartridge wall), while the water vapor barrier is maintained.

It is also possible to use plastics and appropriate additives with which thin walls can be injection-molded or with which the opacity of the cartridge can be increased (less protection against light in production).

SINTERED PISTON (FIG. 15+16)

To permit air-free filling of the cartridge or of the capsule (in the capsule solution without a cartridge), the chambers of the cartridge/capsule

sealed at one end can be filled to a defined level and then closed with pistons. The pistons in this case are designed to be air-permeable, so that the air can escape, while the pistons are pushed into the chambers and therefore no air is trapped in the chambers. The pistons are on the other hand configured in such a way that they are impervious to the paste located in the chambers. Possible solutions in this respect are pistons made of sintered materials, open-pore foams, or small openings in the pistons.

After fitting the pistons, the cartridge/capsule is sealed in order to ensure the necessary storage stability.

If the filled substances require oxygen during storage, the chambers can be extended in length so that a hollow space is obtained between the rear end of the piston and the sealing foil (FIG. 15).

Optionally, the sintered pistons can be combined with the hotmelt sealing principle. In a preferred embodiment, the pistons are only partially porous and have channels for injection of a sealing material (hotmelt) (FIG. 16).

Such pistons can be produced for example by compaction of the sintered material (optionally under the action of heat), by two-component injection-molding, or by foils sealed on at the ends.

After the pistons have been fitted into the chambers filled with dental substance, these are sealed off by injection of the sealing material. During fitting of the pistons, the channels are still open, so that the air displaced when the pistons are moved into the chambers can escape through the porous sinter layer and the channels.

STEPPED CAPSULE WITH HINGE (FIG. 17+18)

It is possible to design the capsule in such a way that a sealable part is obtained, but the capsule can be injection-molded in one tool. The capsule is preferably provided with a hinge which permits a stepped capsule design (small diameter for receiving it in capsule applicator, large diameter for increasing the filling volume). Alternatively, the capsule can also be provided with two hinges (FIG. 17+18), which provides for a hermetic seal at both ends of the substance chambers.

The hinge parts are mounted via non-releasable locking elements, preferably two, three or more, arranged on the circumference of the capsule.

In general a stepped capsule design with or without hinge option can be used to increase the filling volume of the capsule. In this case the rear end of the capsule designed for adapting to an applier is kept unmodified while the diameter of the container part of the capsule can be increased as needed.

IMMERSION FILLING THROUGH PISTONS (FIG. 19+20)

To fill the cartridge/capsule, pistons can first be pushed into the chambers until they reach their end position. The filling needles are then guided through the pistons (FIG. 19). During filling, the pistons are pushed back by the paste pressure and the filling needles are guided back mechanically (principle: immersion filling) (FIG. 20). In this way, inclusion of air in the chambers is avoided. The pistons are preferably made of an elastic material (e.g. rubber), the filling needles piercing through the pistons. After the filling procedure, the filling needles are pulled out, by which means the paste, because of the elastic properties of the piston material, is stripped off from the filling needles. The openings also close automatically because of the elastic properties of the piston material. Nevertheless, the cartridge/capsule can be sealed if required,

the pistons then also being sealed in. It is in turn possible to provide an air volume between sealing foil and the pistons.

Alternatively, the pistons can be made of less elastic material and can be provided with bores.

FILLING FROM FRONT END

It is possible for the cartridge/capsule to be filled from the substance outlet end. In this case, it is recommended to fit the pistons in advance (pistons pushed forwards completely). The pistons are then pressed back during filling, if appropriate to a limit stop, so that the chambers are free from air. In this solution too, it is possible to create an air volume behind the pistons if the cartridge/capsule is longer than is necessary for the filling volume and is sealed at both ends.

AIR CUSHION AT FRONT END OF CARTRIDGE/CAPSULE

It is possible for the cartridge, sealed at one end, to be filled by immersion filling, but not to the brim, and then to seal the second end. The air then enclosed remains at the second end when the filled substances have a high viscosity. If the cartridge is arranged with the "air side" forwards in the capsule, the air is first pressed out when the substance is applied. The substance is then dispensed in exact proportion.

PISTONS WITH INCLINED BORE (FIG. 21)

A further possibility for air-free filling is provided by pistons with inclined air vent channels (FIG. 21). The channels extend from the front end of the piston to the outer wall or shell of the piston. When the pistons are pressed into the chambers, the filled substance can escape outwards through the channels. The piston is sealed off only when it has been pressed in so far that the opening on the shell is located in the chamber. Excess substance can then either be suctioned off or stripped off from the

opening. The piston can optionally be pressed still farther into the chamber if the sealing foil is slightly elastic or thermoformed to provide the necessary volume for this.

OPTIMIZING VOLUME (FIG. 22-24)

In an optional variant, the cartridge design deviates from the round shape. In this way, the capsule housing is only partially weakened, instead of the whole wall of the capsule being made thin. The aim here is to maintain sufficient mechanical strength of the capsule, while the internal volume is increased. Such a solution may be achieved with a substantially square cartridge (FIG. 22). In the area of the cartridge corners, the capsule is weakened or broken through, whereas, in the area of the cartridge sides, the capsule wall consists of thick-walled bridges. These bridges take up the application forces during use of the capsule.

Optionally, the cartridge can also completely replace the capsule (FIG. 23).

In a further design for optimizing the volume of the capsule, the capsule is made wider (FIG. 24). The U-shaped applicator can still be used.

IN-MOULD DECORATION TECHNIQUE FOR ASSEMBLY OF PARTS (FIG. 25)

It may be provided, for example, to injection-mould the pistons directly onto the sealing foil and to use the foil at the same time as a transporter for handling the component parts.

AIR GAP AS DIFFUSION BARRIER (FIG. 26)

It may be provided that a separating or partition wall between two adjacent component chambers is designed as a double wall in order to reduce permeation of substances between the two chambers.

INTEGRAL PISTON WITH HOTMELT CLOSURE (FIG. 27-30)

A preferred solution for air-free filling of the substance is illustrated in FIG. 27-30.

The cartridge and the pistons are formed in one piece (FIG. 27). Between cartridge and pistons there are predetermined breaking points (FIG. 28) which break upon a defined axial loading of the arrangement. The pistons have an external dimension and shape corresponding approximately to the external dimension/shape of the chambers in the cartridge. At their front ends, the pistons preferably have a bead or bulge (FIG. 28) which is slightly overdimensioned in relation to the chambers, while the remaining length of the piston has a slight underdimension (clearance) relative to the chambers.

For filling the piston/cartridge arrangement, the cartridge is sealed off at the front with a foil. The substance is then introduced through the filling bores by means of immersion filling, starting from the sealing foil and in the direction of the mouth of the filling bores. The filling level is preferably such that the substance reaches into the mouth area of the filling bores (FIG. 29). In a further step, the filling bores are then closed off with a material that can harden.

The advantage of this method is that filling tolerances of the substance play no role in relation to air-free filling and in relation to exactly proportioned dispensing of the substance by the customer.

In order to ensure optimal stability of the hotmelt closure, the filling bores in the mouth area to the cartridge are equipped with a double cone. This ensures that the "hotmelt stopper" (FIG. 29) seals by shrinking and that, in the event of excess pressure or low pressure, cannot come loose in the cartridge (e.g. through temperature fluctuations).

The pistons are preferably designed conically or sloping in at the end towards the filling bores (FIG. 30) in order to avoid air inclusions during the immersion filling.

CARTRIDGE WHICH CAN BE SEALED AT BOTH ENDS (FIG. 31-35)

With the solution shown in FIG. 31-35, a cartridge can be filled free from air and can be sealed without appreciable air inclusions. In this case, the chambers of the cartridge have, at least at one end, a narrowing cross section (FIG. 31+35) which creates an enlarged sealing surface on the end face of the cartridge. In the filling procedure by means of immersion filling (FIG. 32+33), the minimum filling level is flush with the end face of the cartridge (right picture of FIG. 33), with filling tolerances giving a slight excess. The enlarged sealing surface has the effect that the possible excess, upon application of the sealing foil, wets only a very small part of the sealing surface and, together with the rest of the sealing surface, leads to a safe and air-free sealing (FIG. 34).

To fill the cartridge flush with the end face, the filling needles are arranged sealingly in the filling openings so that the air displaced during the filling procedure can escape, whereas the paste cannot pass through the gap between the two parts, or only with difficulty. This results in an abrupt pressure increase in the filling unit as soon as the paste reaches the end of the narrowed chamber area. This pressure increase can be detected by the filling unit, and the filling procedure can thus be automatically ended with precision.

Alternatively, filling can be made flush with the end face by placing the filling needle on said end face of the cartridge, but not into the sealing area.

A combination solution can be provided in which the aforementioned piston with hotmelt closure is arranged at one end of the cartridge and the

narrowed area at the other end. This affords advantages in terms of sealing at the front end (larger sealing surface) and one-piece production of the cartridge and of the piston. A preferred production method for this is injection blow molding and subsequent formation of the narrowing because of the difficulty in removing the cartridge interior from the mould.

SEALING THE PISTONS BY MEANS OF SEALING MATERIAL (HOTMELT) (FIG. 36-46)

In one embodiment, the pistons are provided with channels through which a sealant (hotmelt, adhesive, etc.) can be injected. The pistons can first be fitted after the capsule has been filled with paste, and they can then be sealed off by injecting the sealant. It is advantageous here that the paste can thus be enclosed free from air in the chambers.

In a first variant of the solution (FIG. 36+37), the pistons have an annular groove into which sealant can be injected via a filling channel. A seal is thus created between the piston and the inside wall of the chamber. The adhesive is preferably chosen such that it flows easily onto the surface of the chamber and such that it does not form a firm attachment but instead only adheres to the surface. In this way it is possible to move the piston in order to dispense the paste, the sealing material then detaching from the chamber wall (adhesion break) and furthermore acting as a sliding seal. Optionally, the adhesive can be chosen such that it forms a firm connection with the piston and the chamber wall, but itself has a relatively low strength and tears upon displacement of the piston (cohesion break).

Optionally, the sealing material can also be injected through a filling channel in the capsule wall (FIG. 38+39).

In a second variant (FIG. 40+41), after the piston has been fitted, a hollow space remains between the paste and the end face of the piston

(FIG. 40). The filling channel is designed in such a way that, upon injection of the sealing material, this space is filled with sealing material and thus provides a stopper-shaped sealing of the chamber (FIG. 41). The annular groove illustrated is optional and serves for further anchoring of the piston or for creating an additional defined seal.

In a third variant (FIG. 42-44), the chamber filled with paste (FIG. 42) is closed off with sealing material (FIG. 43) and the piston is then fitted into the still soft sealing material (FIG. 44). In this process, the piston does not pass through the sealing material layer. In this way, a simple air-free closure is obtained. Closure of a two-chamber capsule affords the added advantage that the filling level of the paste does not have to be exactly the same in both chambers and the filling level of the sealing material also does not have to exactly correspond. The piston is configured in such a way that excess sealing material can escape in a riser tube arranged in the piston (FIG. 44).

Alternatively, the cooled sealing material could itself serve as a stopper. In this case, the piston would not be pressed into the soft sealing material. The piston would then only be used for transmitting force for advancing the piston.

In a fourth variant (FIG. 45+46), the piston itself has sealing means (e.g. sealing beads or bulges). In this variant, the chamber is preferably filled from the front end of the capsule (FIG. 45), the piston being pushed or drawn back with the paste filling level. In the end position of the piston (FIG. 46), the latter is then fixed and sealed off by means of a sealing material according to one of the abovementioned methods.

It may be provided that the front end of the capsule (FIG. 47) has channels which are filled with sealing material after a pivoting cannula has been fitted. In FIG. 48+49, the capsule is in ochre, the pistons are in

green, the pivoting cannula is in red, and the cap for fixing the cannula is in blue.

TWO-COMPONENT INJECTION-MOLDING WITH POSSIBILITY OF MIXER ASSEMBLY (FIG. 50)

The embodiment shown in FIG. 50 permits production of the capsule with pivoting cannula in the two-component injection-molding process, the pivoting cannula preferably being molded first, then the capsule, and the pivoting cannula being encapsulated by the capsule so that the chambers arranged in the capsule and intended to receive the dental substance are closed off tight at the cannula side. The plastics used for both parts and the process parameters in the injection-molding procedure are chosen so that, after production, a press-fit between both parts is obtained, and preferably the surfaces of both parts form a detachable connection (light adhesion). The capsule is thus sealed off tight in the storage condition. Opening of the capsule is possible, however, by pivoting the cannula.

Examples of suitable plastics for the proposed technique are polyolefins, preferably polypropylene, for both parts.

A bore arranged in the capsule allows the mixer to be fitted on the already injection-molded capsule.

TWO-COMPONENT ASSEMBLY INJECTION-MOLDING WITH ADDITIONAL INJECTION-MOLDED SEALING (FIG. 51)

In the embodiment shown in FIG. 51, cannula and capsule are produced in a two-component injection-molding process, but without sealing of the substance chambers (assembly injection molding).

Between pivoting cannula and the outlet channel of the capsule, a hollow space remains which can later be filled with a sealing material. After production, the capsule is preferably first filled with the dental substance and

then closed by injection of the sealing material. During the filling of the capsule with dental substance, the unsealed capsule end (depending on the filling method) can be used to remove air.

FITTING CANNULA WITH OPTIONAL SEALING BY OVER-MOLDING (FIG. 52-54)

A further possibility for producing the capsule with cannula lies in the formation of a snap-fit connection. The two parts are injected separately and are interlocked in a non-releasable manner by means of a snap-fit connection (FIG. 52+53). It order to ensure a secure fit when the snap-fit connection is loaded, the elastic components can be over-molded (FIG. 54). This can also be done so as to seal the capsule at the same time (not illustrated).

CAPSULE WITH STATIONARY PISTON AND ONE-PIECE PISTON ASSEMBLY (FIG. 57-60)

The capsules in the embodiments shown in FIG. 57-60 provide a means to store, static mix and directly deliver the mixed material. The piston assembly (green in FIG. 57-60) is one piece with a breakable seal between the inner and outer pistons.

The capsule in the embodiment of FIG. 57+58 is placed in a dispensing gun and when actuated pushes on the inner piston. The capsule seal opens when the seal of the outer piston contacts the stationary capsule piston (blue in FIG. 57+58). As the inner piston is pushed in, the pastes are pushed out into the static mixer and mixed for delivery out the tip.

The capsule in the embodiment of FIG. 59+60 is placed in a dispensing gun and actuated which pushes in the piston. The inner piston moves the outer piston in until the seals are opened when it contacts the stationary capsule piston (orange in FIG. 59+60). The lock disengages the inner pis-

ton from the outer piston when the inner piston travels to the unlocking position. This allows the inner piston to separate from the outer piston by breaking the seal between the two pistons. The inner piston is allowed to continue to travel to push the mixed material out the dispensing tip.

The present invention has now been described with reference to several embodiments thereof. It will be apparent to those skilled in the art that many changes can be made in the embodiments described without departing from the scope of the present invention. Thus the scope of the present invention should not be limited to the structures described in this application, but only by structures described by the language of the claims and the equivalents of those structures.

CLAIMS

1. A capsule for two or more components of a material which are to be mixed together, comprising:

- a cartridge comprising a first component chamber for containing a first component and a second component chamber for containing a second component;
- a housing comprising an outlet and a cartridge chamber for holding the cartridge, the cartridge chamber being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

2. A capsule for two or more components of a material which are to be mixed together, comprising:

- a first cartridge comprising a first component chamber for containing a first component;
- a second cartridge comprising a second component chamber for containing a second component;
- a housing comprising an outlet and a cartridge chamber for holding the cartridges, the cartridge chamber being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

3. A capsule for two or more components of a material which are to be mixed together, comprising:

- a first cartridge comprising a first component chamber for containing a first component;
- a second cartridge comprising a second component chamber for containing a second component;

- a housing comprising an outlet, a first cartridge chamber for holding the first cartridge, and a second cartridge chamber for holding the second cartridge, the first and second cartridge chambers being connected to the outlet;
- a first piston for movement within the first component chamber;
- a second piston for movement within the second component chamber.

4. Capsule according to any of the preceding claims, wherein the cartridge is made from a different material than the housing.

5. Capsule according to any of the preceding claims, wherein the cartridge is made from a different material than the piston.

6. Capsule according to any of the preceding claims, wherein the housing is made from a different material than the piston.

7. Capsule according to any of the preceding claims, wherein the first piston is connected to or formed in one piece with the second piston.

8. Capsule according to any of the preceding claims, wherein at least one of the pistons is connected to or formed in one piece with at least one of the cartridges.

9. Capsule according to any of the preceding claims, wherein at least one of the component chambers has at least one opening closed by a seal.

10. Capsule according to any of the preceding claims, wherein the seal is a film attached to the cartridge.

11. Capsule according to any of the preceding claims, wherein the seal is formed in one piece with the cartridge.

12. Capsule according to any of the preceding claims, wherein the seal is a membrane formed in one piece with the cartridge.

13. Capsule according to any of the preceding claims, comprising a piercing member for piercing the seal.

14. Capsule according to any of the preceding claims, wherein the first component chamber has a rear opening closed by the first piston.

15. Capsule according to any of the preceding claims, wherein:
- the first piston has a front end;
- the first component chamber has a rear opening for receiving the first piston;
- the front end is connected to or formed in one piece with a part of the cartridge surrounding the rear opening and closes the rear opening.

16. Capsule according to any of the preceding claims, wherein the first component chamber has a rear section holding a plug.

17. Capsule according to any of the preceding claims, wherein the plug is formed in one piece with a part of the cartridge surrounding the rear section.

18. Capsule according to any of the preceding claims, wherein the plug is made from a different material than the cartridge.

19. Capsule according to any of the preceding claims, wherein the plug comprises a through hole running from the outside to the inside of the first component chamber.

20. Capsule according to any of the preceding claims, wherein:
- the plug has a rear face;
- the plug comprises a filling nipple protruding from the rear face;

- the through hole runs through the filling nipple.

21. Capsule according to any of the preceding claims, comprising a stopper for closing the through hole.

22. Capsule according to any of the preceding claims, wherein the plug has a front face with a funnel shaped surface leading to the through hole.

23. Capsule according to any of the preceding claims, wherein:
- the plug is made from an elastic material;
- the through hole is collapsed at least when the plug sits in the first component chamber.

24. Capsule according to any of the preceding claims, wherein:
- the cartridge comprises an outer wall with a cylindrical outer surface;
- the cartridge chamber comprises a cylindrical inner surface facing the outer surface when the cartridge is held in the cartridge chamber;
- a tongue and groove joint is provided on the outer surface and the inner surface.

25. Capsule according to any of the preceding claims, wherein:
- the cartridge comprises a partition wall between the first component chamber and the second component chamber;
- the groove of the tongue and groove joint runs along the line where the partition wall meets the outer wall.

FIG. 1

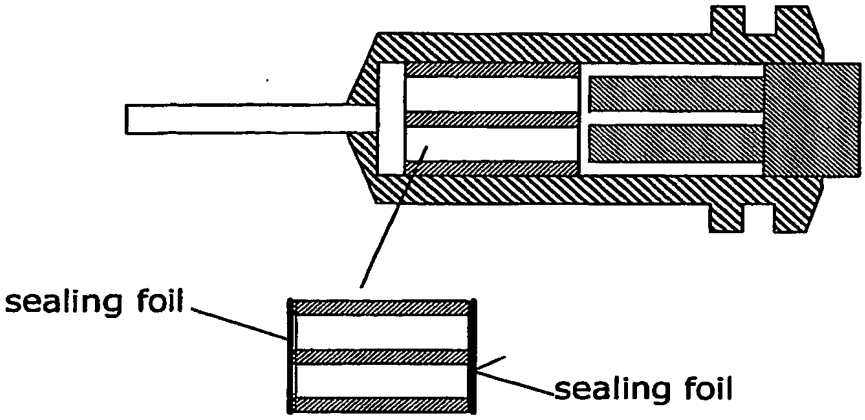

FIG. 2

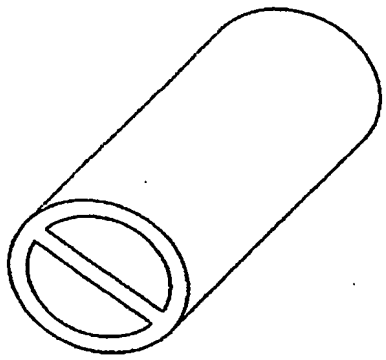

FIG. 3

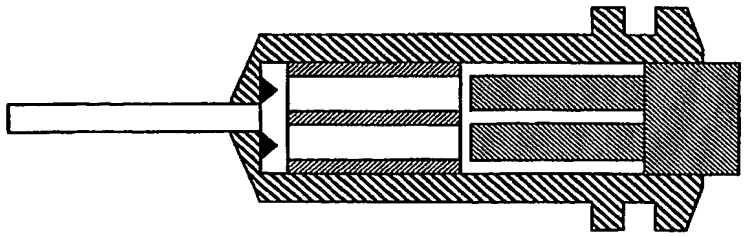

FIG. 4

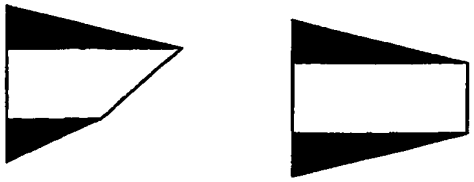

FIG. 5

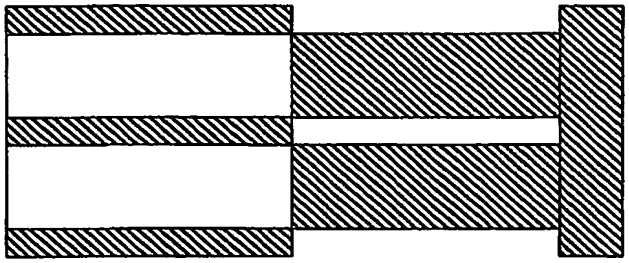

FIG. 6

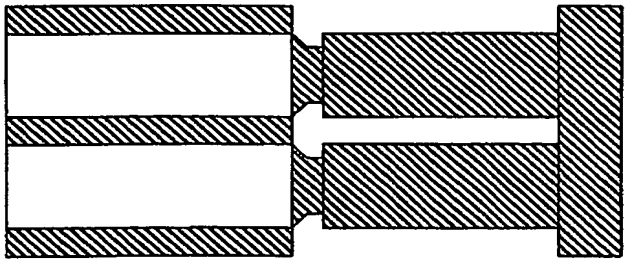

FIG. 7

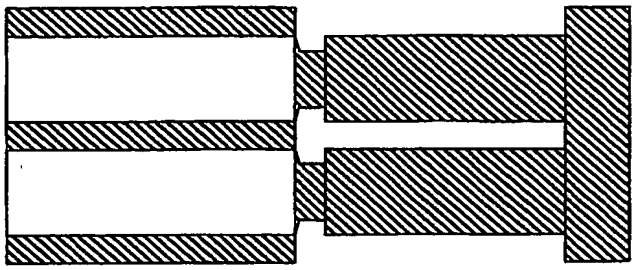

FIG. 8

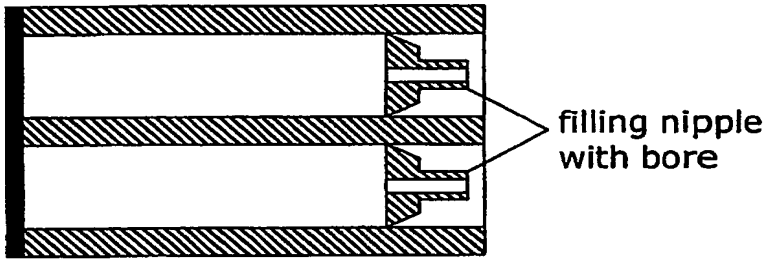

FIG. 9

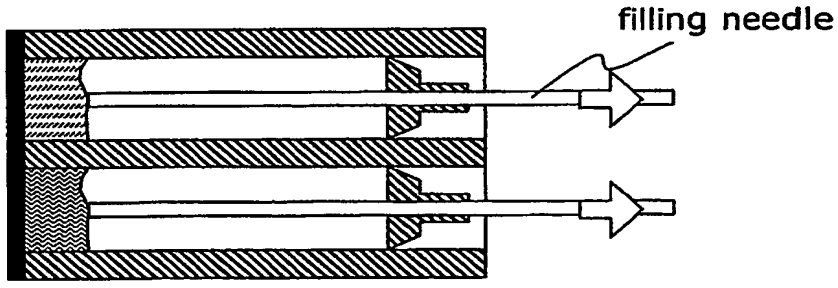

FIG. 10

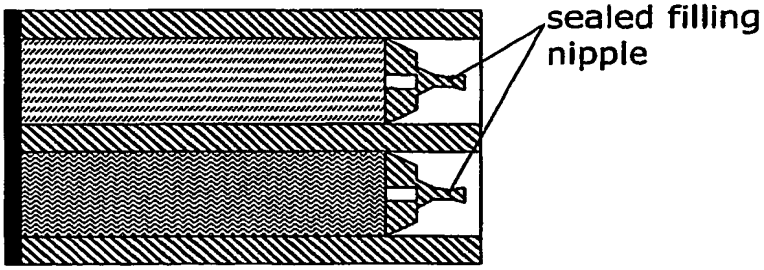

FIG. 11

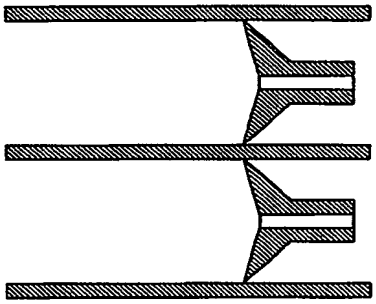

FIG. 12

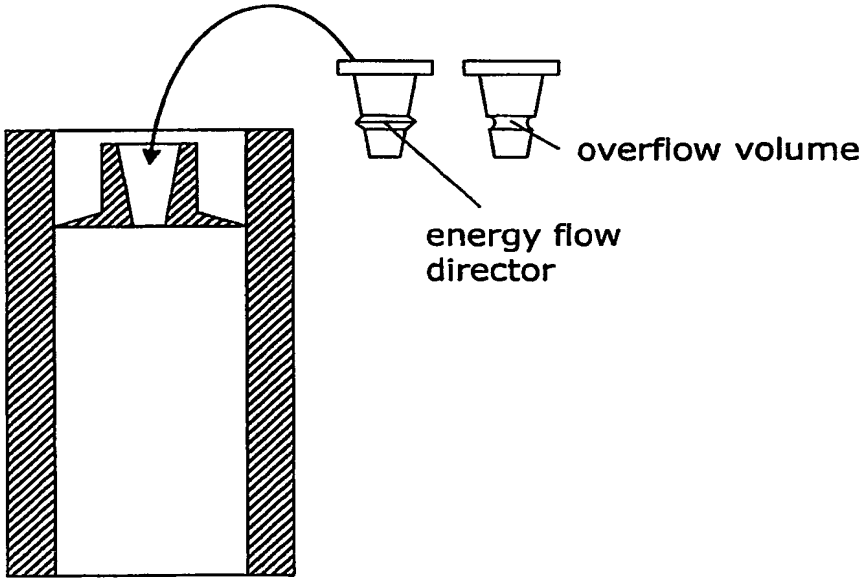

FIG. 13

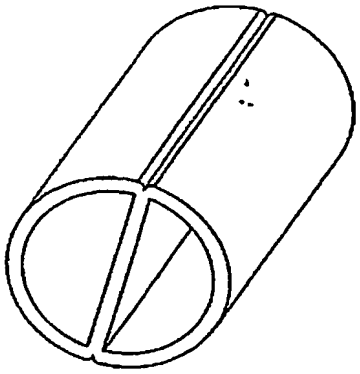

FIG. 14

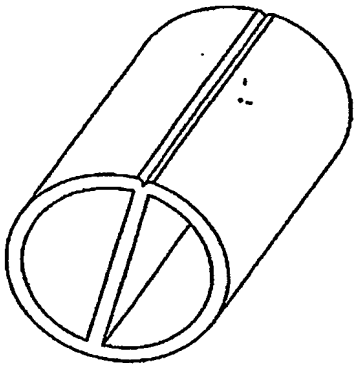

FIG. 15

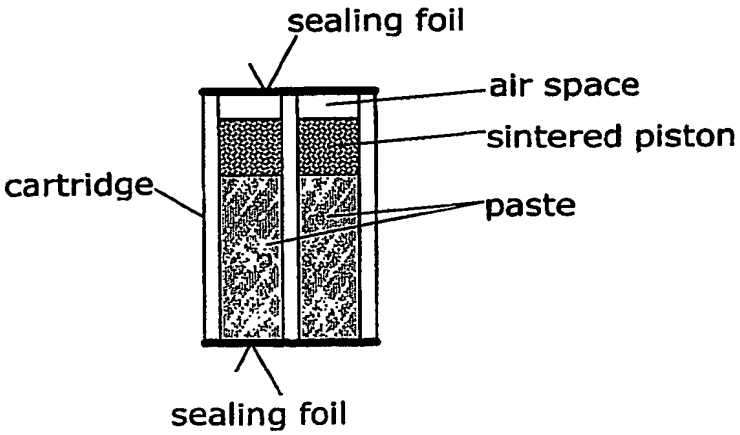

FIG. 16

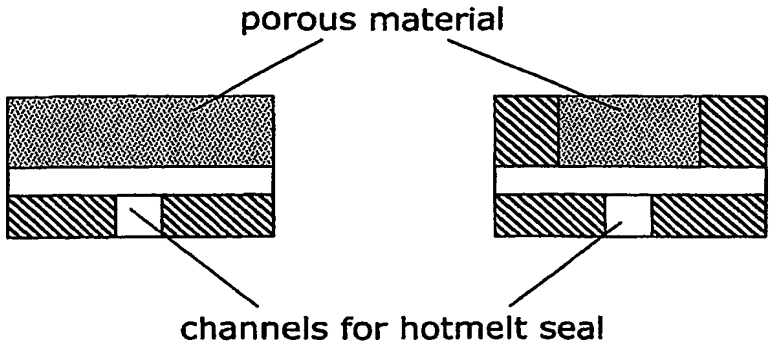

FIG. 17

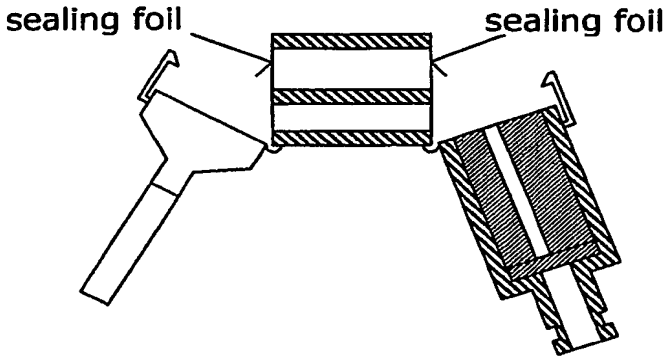

FIG. 18

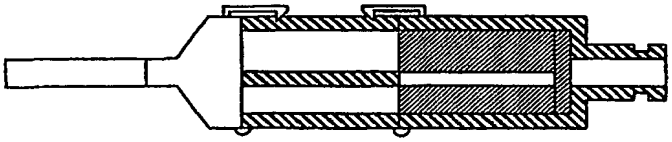

FIG. 19

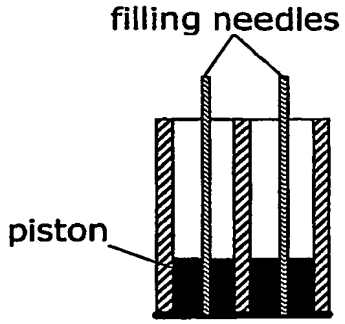

FIG. 20

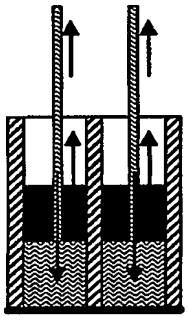

FIG. 21

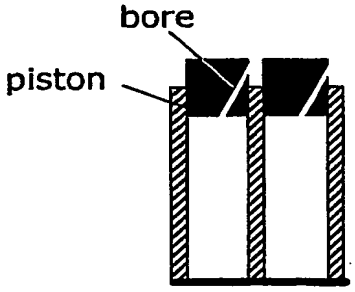

FIG. 22

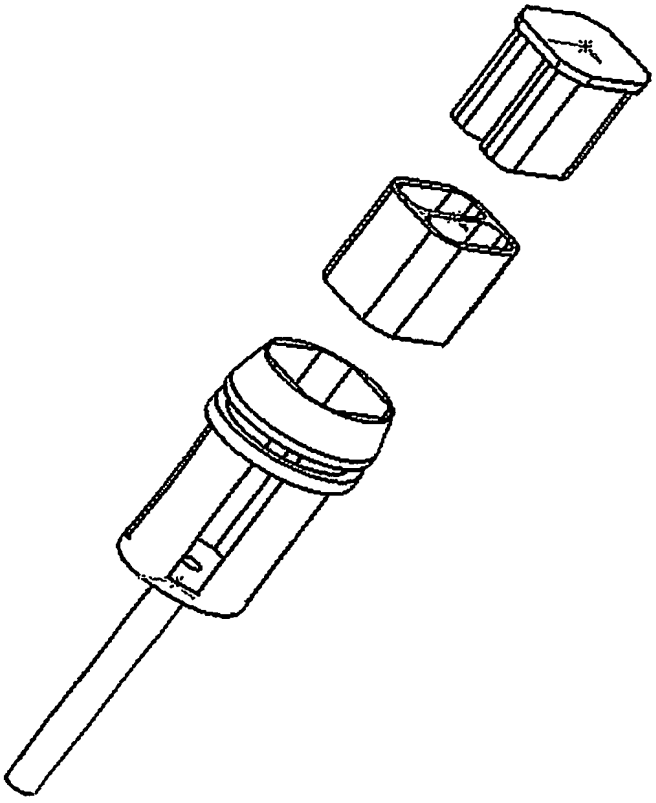

FIG. 23

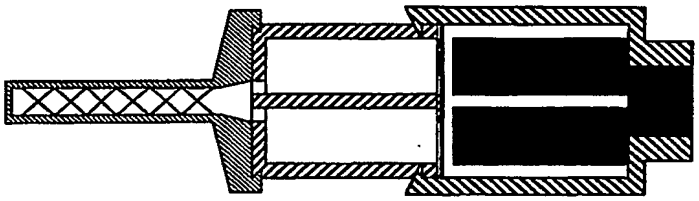

FIG. 24

cross-section of cartridge

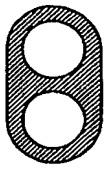

FIG. 25

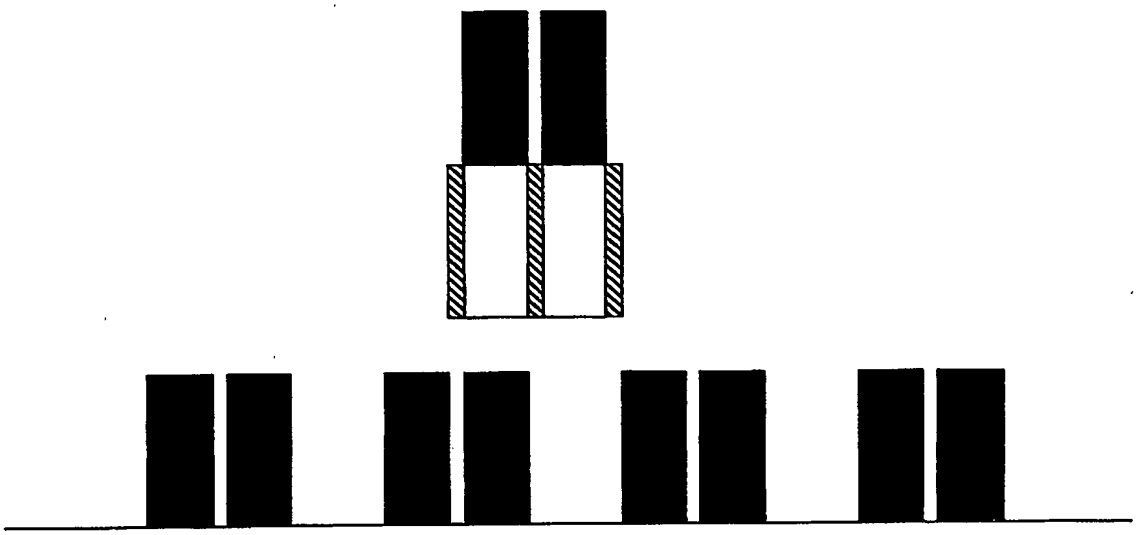

FIG. 26

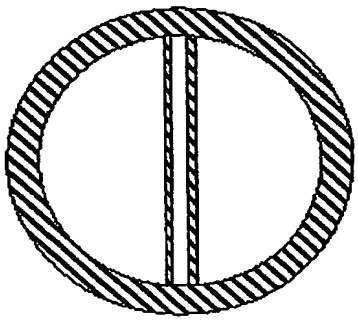

FIG. 27

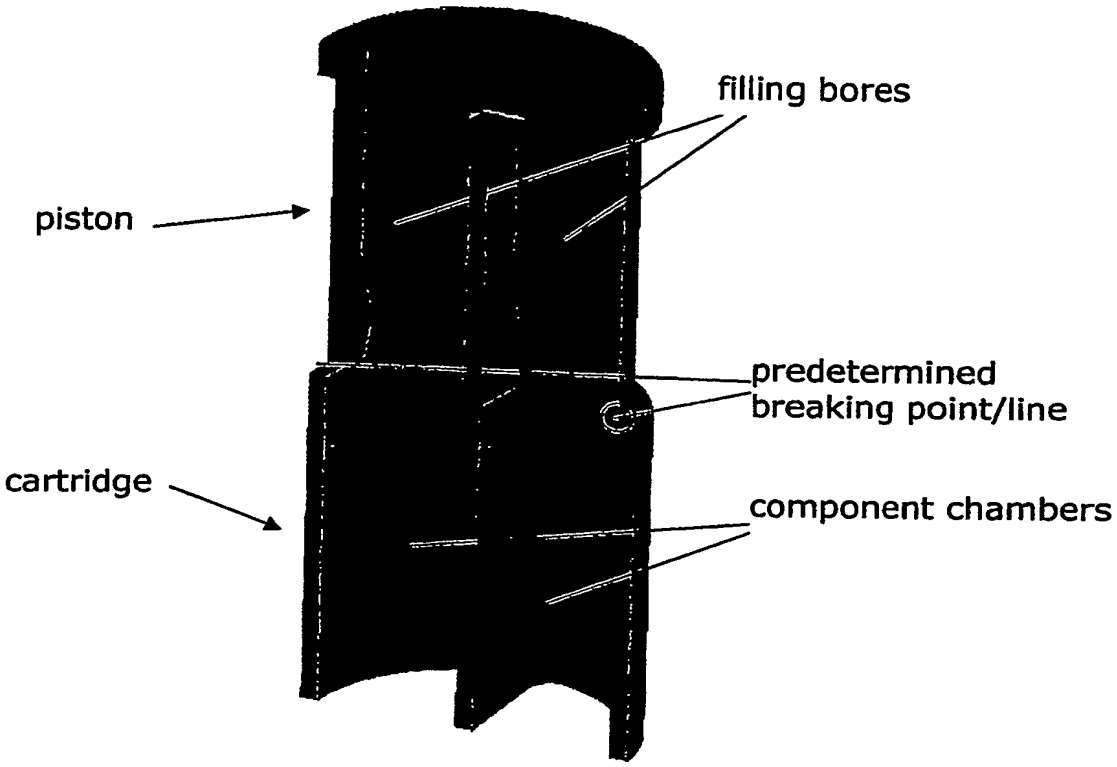
filling bores
piston
predetermined
breaking point/line
cartridge
component chambers

FIG. 28

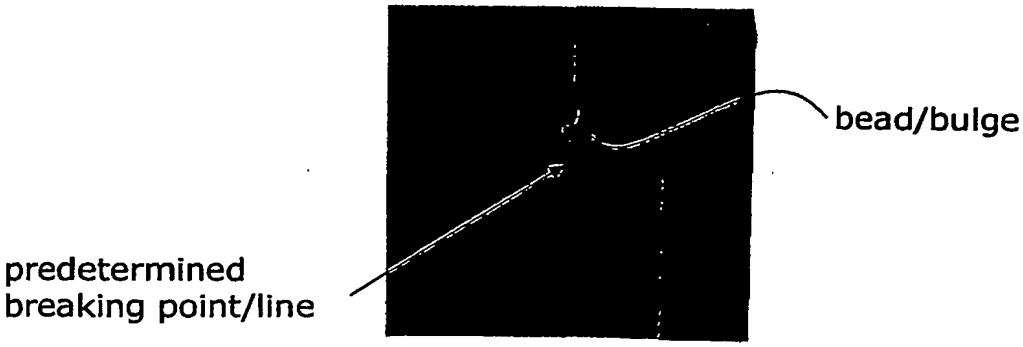
bead/bulge
predetermined
breaking point/line

FIG. 29

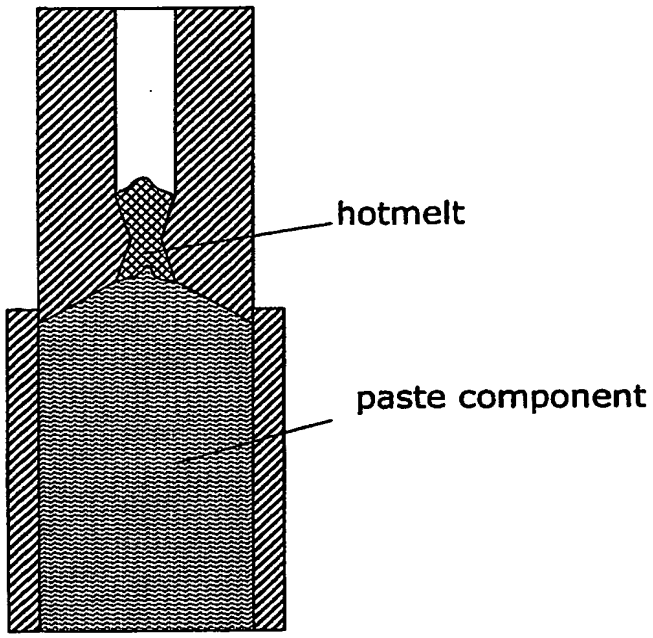
hotmelt
paste component

FIG. 30

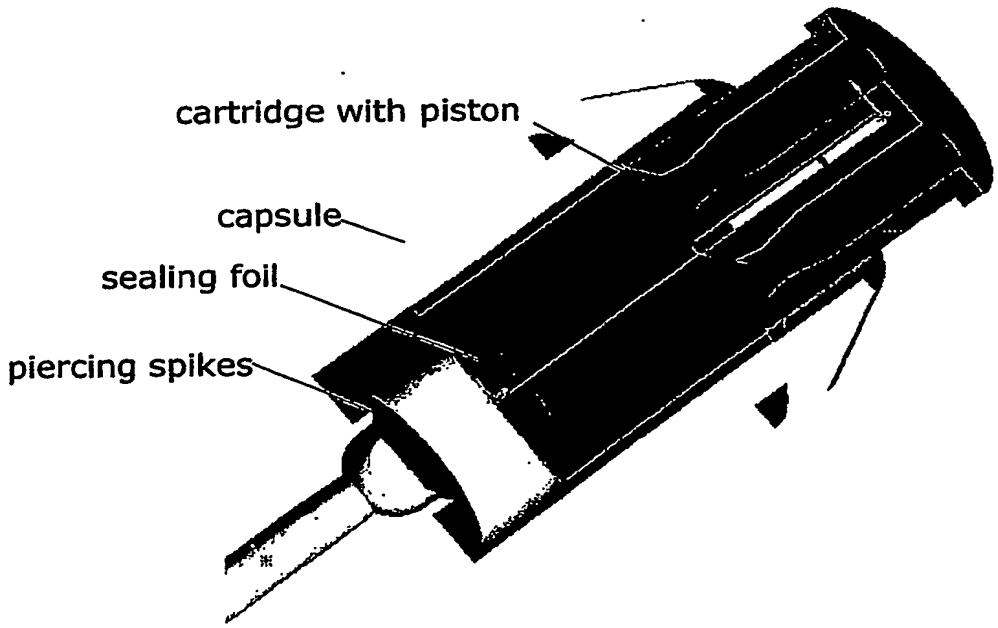
cartridge with piston
capsule
sealing foil
piercing spikes

FIG. 31

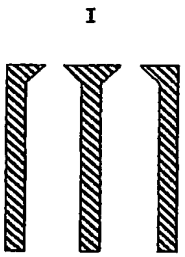

FIG. 32

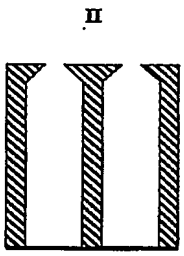

FIG. 33

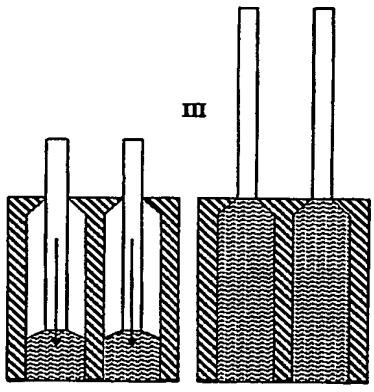

FIG. 34

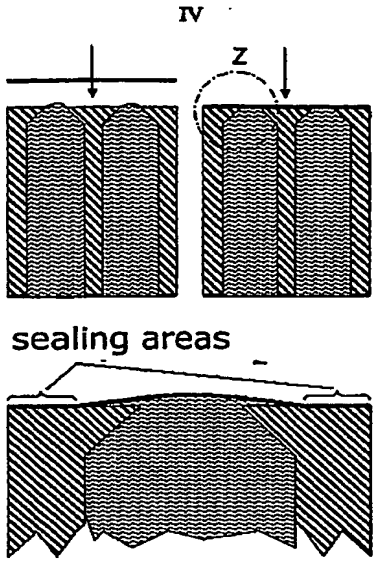

FIG. 35

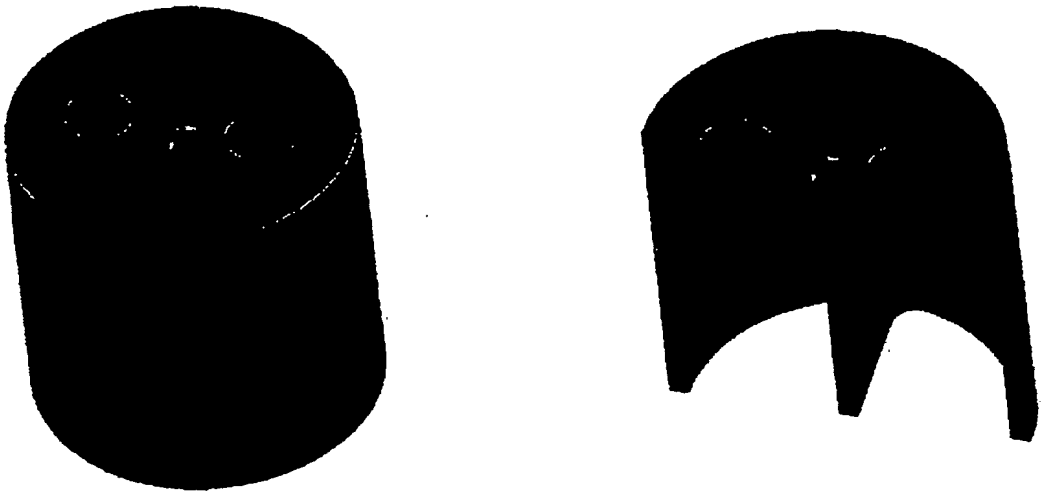

FIG. 36

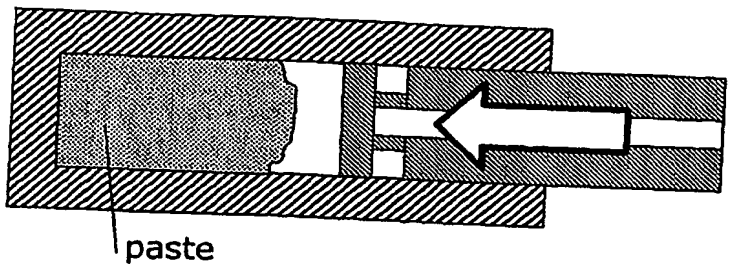

FIG. 37

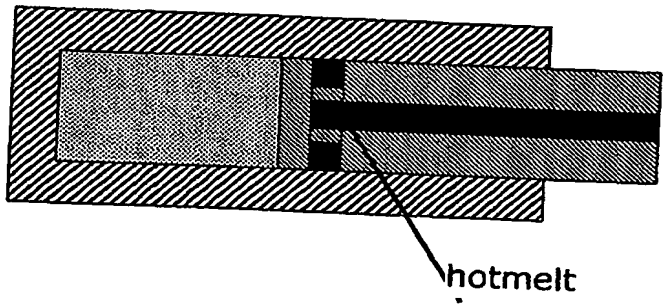

FIG. 38

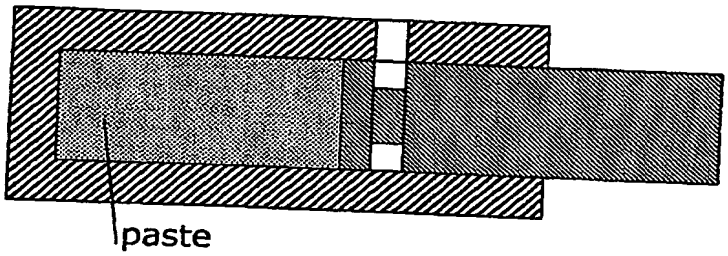

FIG. 39

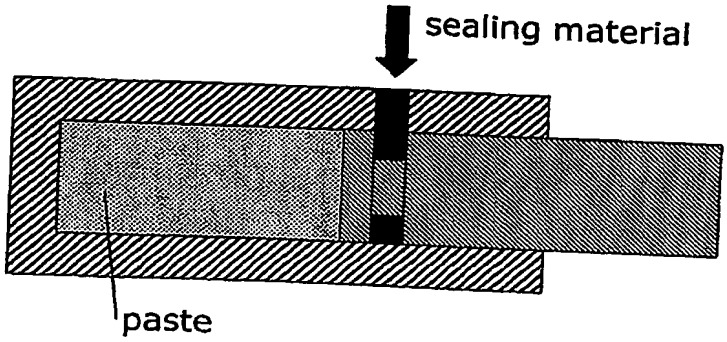

FIG. 40

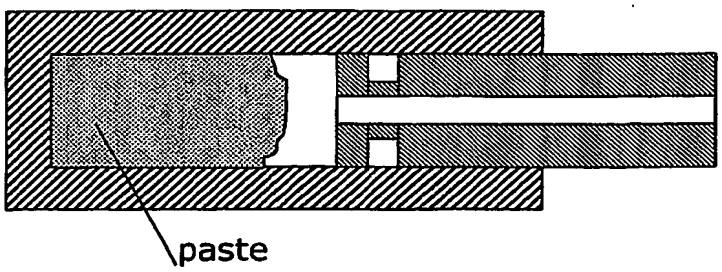

FIG. 41

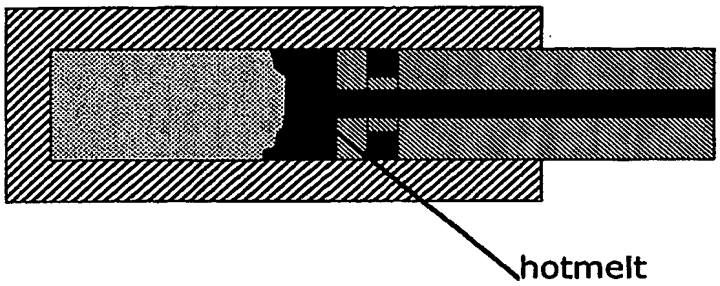

FIG. 42

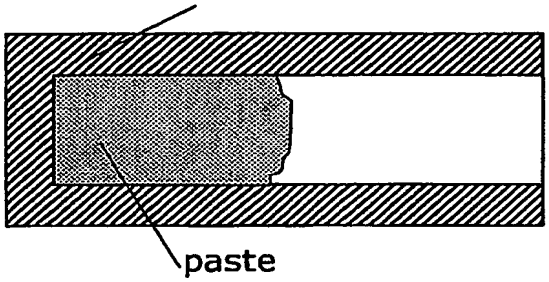

FIG. 43

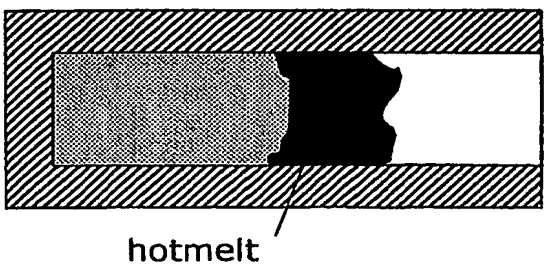

FIG. 44

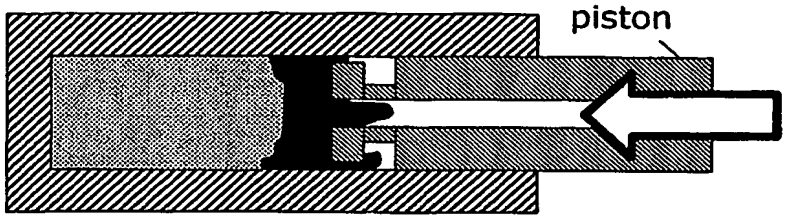

FIG. 45

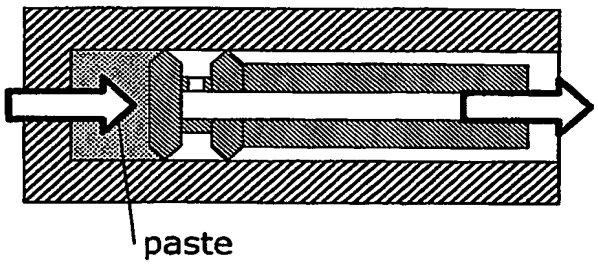

FIG. 46

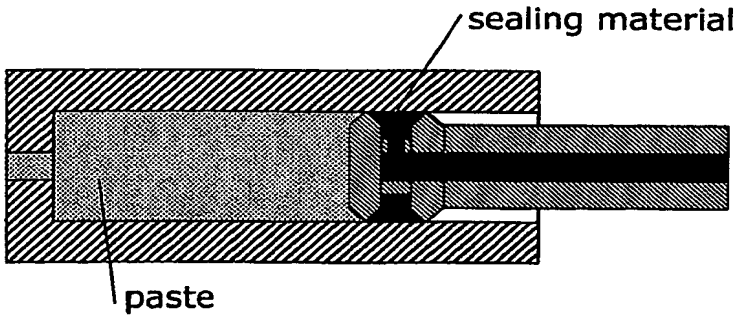

FIG. 47

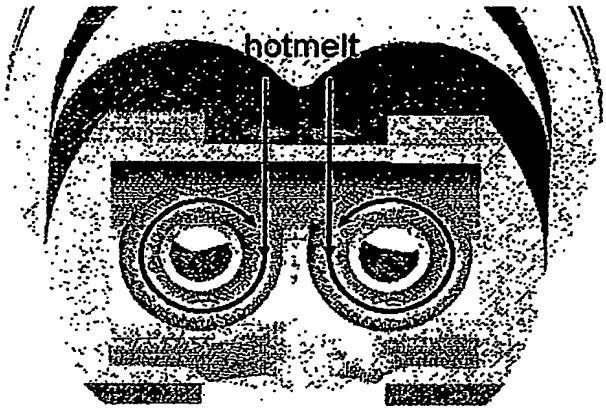

FIG. 48

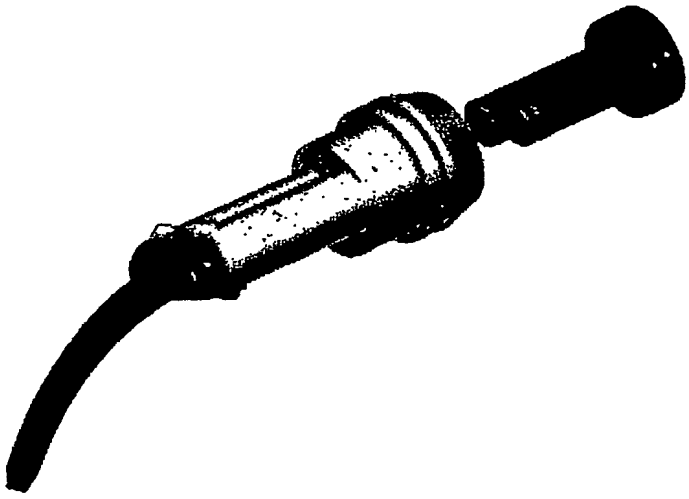

FIG. 49

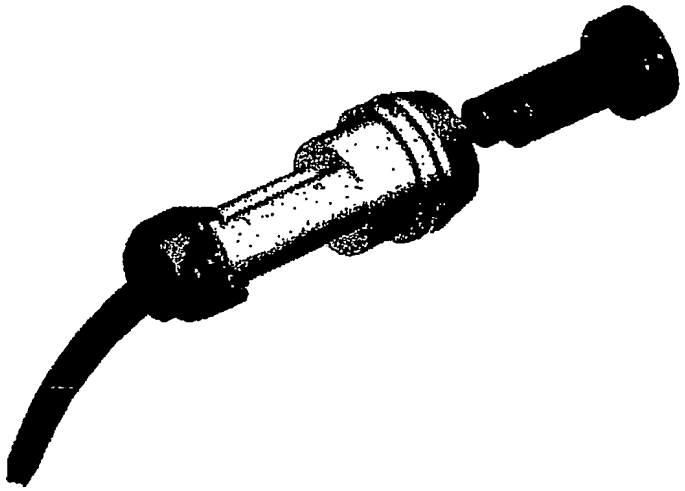

FIG. 50

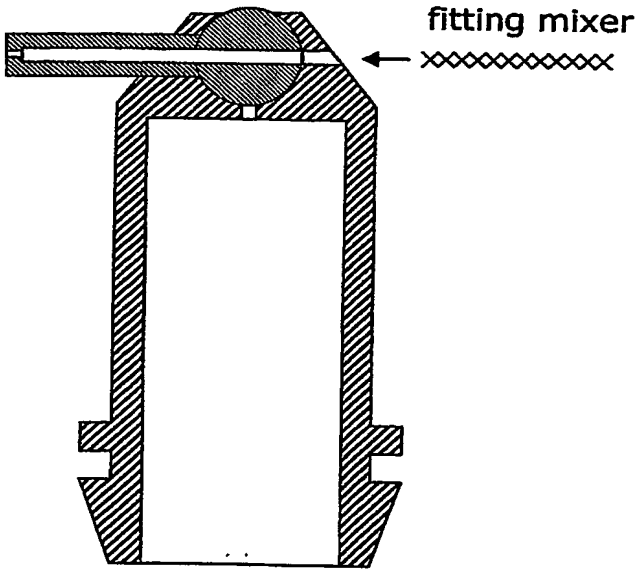

FIG. 51

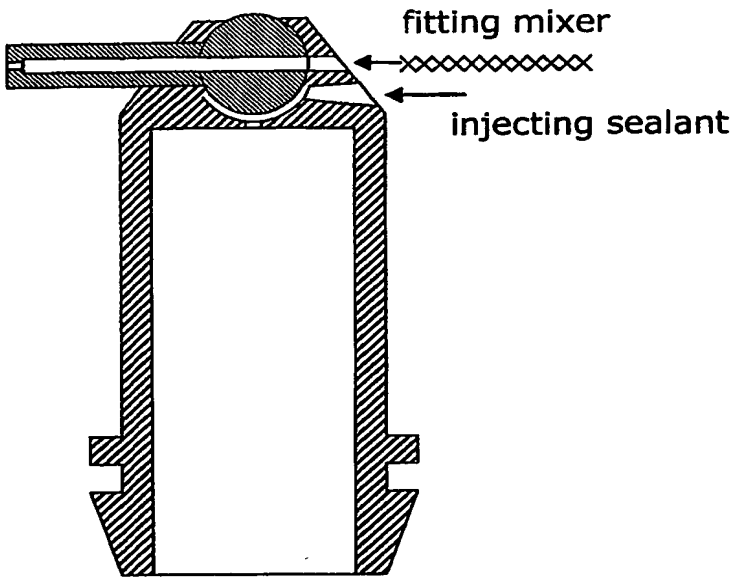

FIG. 52

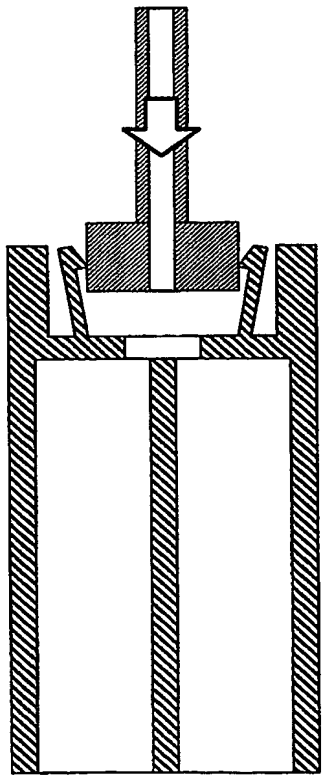

FIG. 53

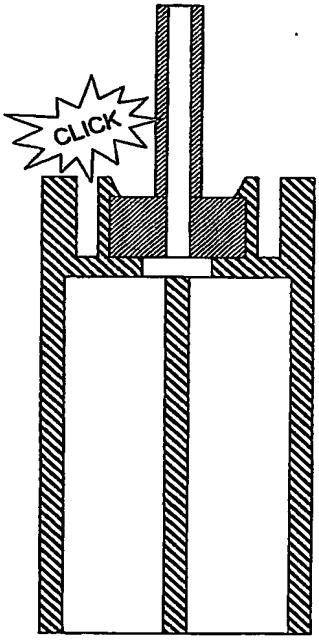

FIG. 54

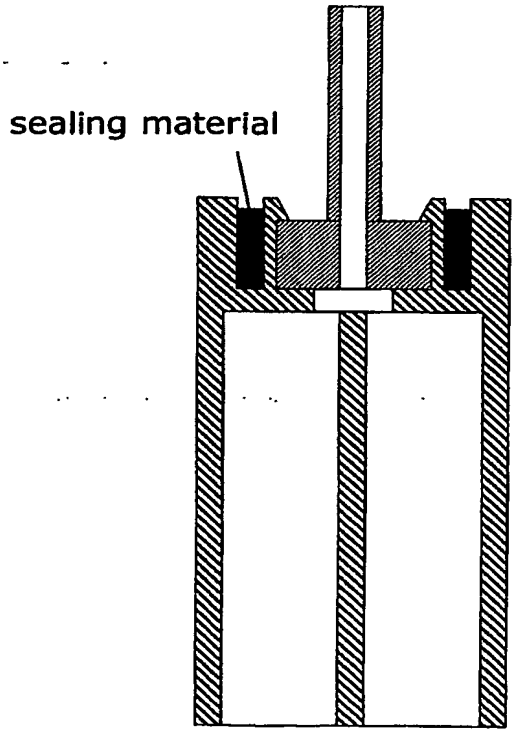

FIG. 55

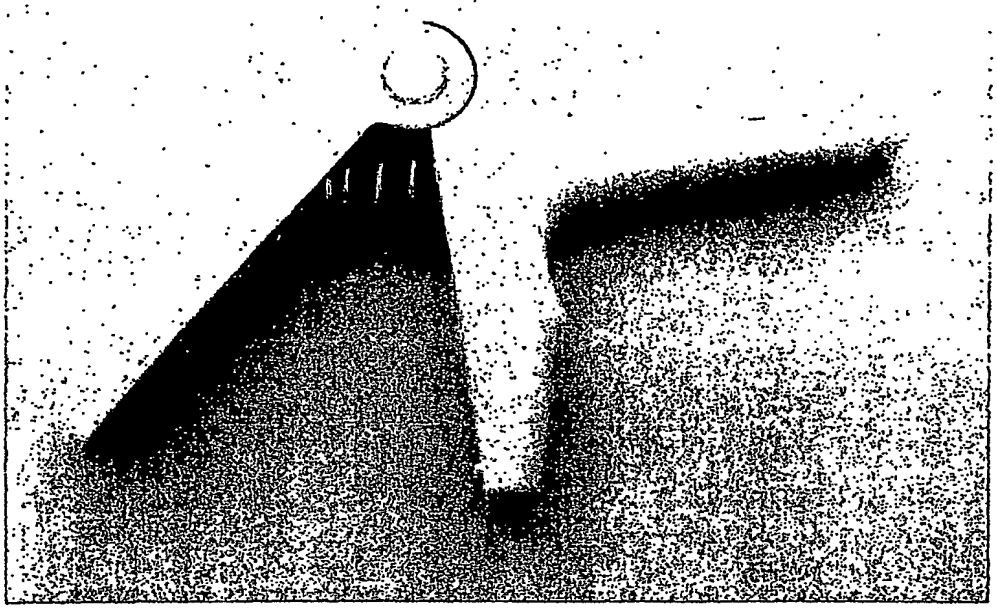

FIG. 56

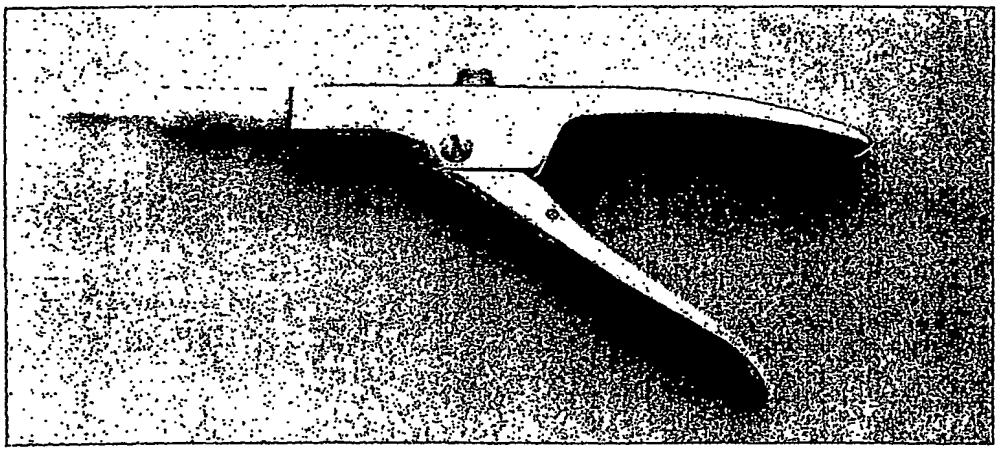

FIG. 57

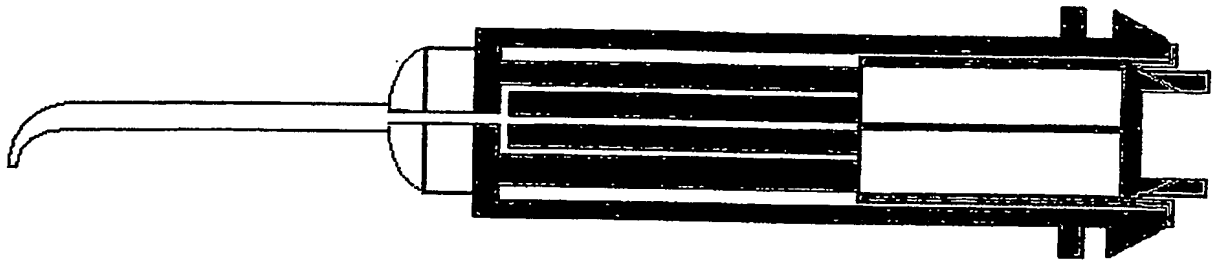

FIG. 58

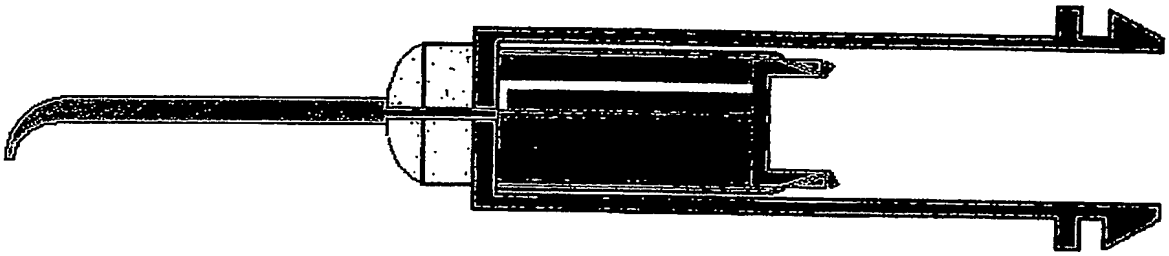

FIG. 59

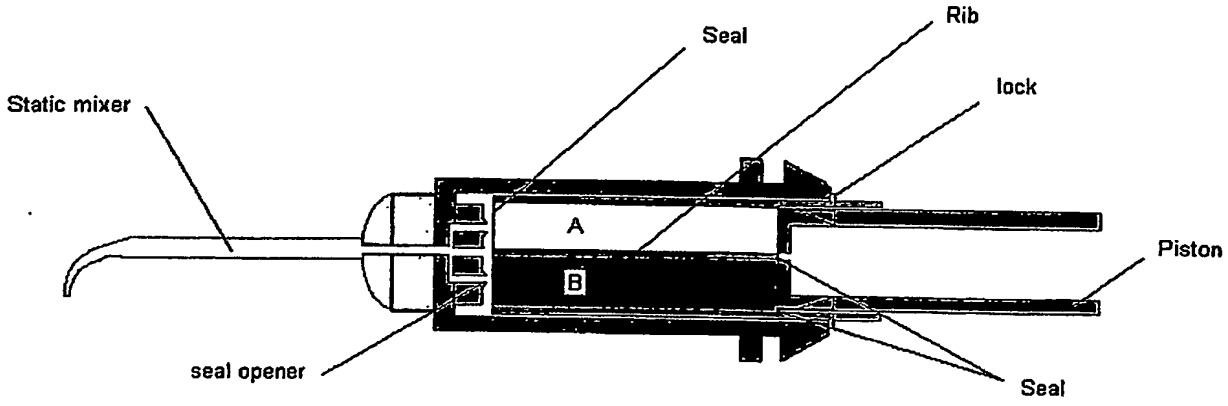

FIG. 60